

TENDER SPECIFICATION

Non-Destructive Testing (NDT) of Components (NON-DESTRUCTIVE TESTING)

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Note: Only latest amendments and/or additions are reflected in italics in the body of the document.

DOCUMENTATION SIGN-OFF SHEET

I, the undersigned hereby approve this specification.

| ROLE | CAPACITY/ FUNCTION | SIGNATURE | DATE |
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TABLE OF CONTENTS

| | |
|---|----|
| 1. PURPOSE | 5 |
| 2. APPLICABILITY | 5 |
| 3. REFERENCE DOCUMENTS | 5 |
| 4. DEFINITIONS AND ABBREVIATIONS | 6 |
| 4.1 Definitions – N/A | 6 |
| 4.2 Abbreviations..... | 6 |
| 5. ACCOUNTABILITY, RESPONSIBILITY AND AUTHORITY | 7 |
| 6. SCOPE OF WORK | 7 |
| 7. AREA OF WORK | 10 |
| 8. DESCRIPTIONS TO RENDER SERVICES | 11 |
| 9. COMPANY FILE AND REQUIRED DOCUMENTATIONS | 11 |
| 10. PREPARATIONS AND REQUIREMENTS FOR RADIOGRAPHIC TESTING (RT) | 14 |
| 11. TEST RECORDS..... | 17 |
| 12. TESTING OF THE REPAIRS..... | 19 |
| 13. ACCEPTANCE STANDARD | 19 |
| 14. PERSONNEL QUALIFICATION | 19 |
| 15. QUALITY OF WORK..... | 19 |
| 16. RECORDS KEEPING | 20 |
| 17. HEALTH AND SAFETY / CAUTIONARY MEASURES..... | 20 |
| 18. KNOWLEDGE | 21 |
| 19. RECORDS | 21 |
| 20. ANNEXURES | 21 |
| ACKNOWLEDGEMENT AND ACCEPTANCE OF SPECIFICATION..... | 22 |

1. PURPOSE

The purpose of this document is to outline the requirement for non-destructive testing service provider to conduct examinations, measuring or testing on welded railways components and pressure equipment's manufactured and/or assembled at Wagons Manufacturing, Transnet Engineering.

2. APPLICABILITY

This specification applies to Transnet Engineering and its suppliers.

3. REFERENCE DOCUMENTS

PD 5500: Specification for unfired pressure vessels

ASME Section V: Nondestructive Examination.

ASME Section VIII: Rules for Construction of Pressure Vessels.

ASME Section IX: Welding, Brazing, and Fusing Qualifications

ANSI NB-23 Part 2: National Board Inspection Code – Inspection.

BS EN ISO 9606-1: Qualification testing of welders - Fusion welding - Part 1: Steels

BS EN ISO 15614-1: Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys.

ISO 5817: Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections.

BS EN 15085 Part 1-5: Railway applications — welding of railway vehicles and components

BS EN ISO 3834 Part 1-6: Quality requirements for fusion welding of metallic materials

BS EN ISO 9712: Non-destructive testing — Qualification and certification of NDT personnel.

BS EN ISO 17635: Non-destructive testing of welds. General rules for metallic materials.

BS EN ISO 17636 Part 1-2: Non-destructive testing of welds. Radiographic testing.

BS EN ISO 17637: Non-destructive testing of welds. Visual testing of fusion-welded joints.

BS EN ISO 17638: Non-destructive testing of welds. Magnetic particle testing.

BS EN ISO 17639: Destructive tests on welds in metallic materials. Macroscopic and microscopic examination of welds.

BS EN ISO 17640: Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels, and assessment.

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions – N/A

- **Rail Tank Car** – Tank Wagon transporting highly flammable products, i.e., petrol, anhydrous ammonia, etc.
- **Vessel or Pressure Vessel** – The barrel or tank part of the rail tank car/wagon.
- **On-site** – On the premises of Transnet Engineering.
- **Inspection** – Activities such as measuring, examining, testing, etc.
- **Repair** – To restore pressure-retaining items to a safe and satisfactory operating condition.
- **Latest** – Latest Specification, Standards, or codes.
- **OHS Act** – Act 85 of 1993, vessels under pressure act.

4.2 Abbreviations

- **AWS** – American Welding Society
- **ASME** – American Society of Mechanical Engineers
- **ISO** – International Organization for Standardization
- **SANS** – South African National Standards
- **SANAS** – South African National Accreditation System
- **AAR** – Association of American Railroads
- **NBIC** – National Board Inspection Code.
- **SOP** – Standard Operating Procedures
- **PPE** – Personal Protective Equipment
- **PER** – Pressure Equipment Regulation
- **IQI** – Image Quality Indicators
- **NDT** – Non-Destructive Testing
- **RT** – Radiographic Inspection

- **AIA** – Approved Inspection Authority
- **OHS** – Occupational Health and Safety
- **IRCP** – International Commission on Radiological Protection
- **EPD** – Electronic Personal Dosimeter
- **EN** – European Standard.
- **PQR** – Procedure Qualification Record
- **WPS** – Welding Procedures Specification
- **WPQ** – Welder Performance Qualification

5. ACCOUNTABILITY, RESPONSIBILITY AND AUTHORITY

All stakeholders involved in the selection of the service provider must ensure that any necessary deviations from this specification are documented and approved by the responsible originator before proceeding with the contract award.

6. SCOPE OF WORK

The service provider is required to conduct and provide non-destructive testing services on weldments, castings and forgings components manufactured at Transnet Engineering or on behalf of Transnet Engineering. The details of these tests are given in the 'Table 1: Scope of work'. These test methods are also typically used as part of railway new build and maintenance. The NDT service provider will be required to:

- Conduct Magnetic Particle Testing (MT),
- Conduct Ultrasonic Testing (UT),
- Conduct Visual Testing (VT),
- Conduct Penetrant Testing (PT),
- Conduct Radiographic Testing (RT),
- Conduct Replica, and
- Provide NDT level 3 Services,
- Provide qualified, authorised, and experienced personnel to perform non-destructive testing services as per Table 1: Scope of work.
- All tasks must be conducted in accordance with ISO, AWS, PD5500, ASME standards or whichever code is recommended.

- The service provider will be responsible for arranging all NDT related activities.
- Regular audits are expected to be performed.
- All services will be rendered as and when required.
- See Table 1. Below for more.

Table 1: Scope of work

| Item No. | Service Identification | Service Description |
|-----------|--|---|
| 068018028 | Ultrasonic Testing (UT) Onsite Testing | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>NDT Cost: Setup, UT, Inspections of manufactured products and welds, issuing report/results including travelling and marking of defects location.</p> <p>Extent of Testing: Testing of welds internal or external as per request</p> <p>NDT Personnel: Must be in possession of a valid ISO 9712/PCN UT Level II qualifications</p> |
| 068019636 | Radiographic Testing (RT) Onsite Testing (x-ray) | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>NDT Cost: Setup, RT, Inspections of manufactured products and welds, issuing of report/results including, travelling, delivery of the films, marking of defects location and issuing a tracing paper.</p> <p>Extent of Testing: Testing of welds internal or external as per request</p> <p>NDT Personnel: Must be in possession of a valid ISO 9712/PCN RT Level II qualifications</p> |
| 068019637 | Magnetic Particle Testing (MT) Onsite Testing (MPI) | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>NDT Cost: Setup, MT, Inspections of manufactured products and welds, issuing report/results including travelling and marking of defects location.</p> <p>Extent of Testing: Testing of welds internal or external as per request</p> <p>NDT Personnel: Must be in possession of a valid ISO 9712/PCN MT Level II qualifications</p> |

| | | |
|--------------------|---|---|
| 068019638 | Penetrant Testing (PT) Onsite Testing (Red dye) | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>NDT Cost: Setup, PT, Inspections of manufactured products and welds, issuing report/results including travelling and marking of defects location.</p> <p>Extent of Testing: Testing of welds internal or external as per request</p> <p>NDT Personnel: Must be in possession of a valid ISO 9712/PCN PT Level II qualifications</p> |
| 068020726 | Visual Testing (VT) Onsite Testing | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>NDT Cost: Setup, VT, Inspections of manufactured products and welds, issuing report/results including travelling and marking of defects location.</p> <p>Extent of Testing: Testing of welds internal or external as per request</p> <p>NDT Personnel: Must be in possession of a valid ISO 9712/PCN VT Level II qualifications</p> |
| 90014070BTT | Thickness Measurements | <p>To measure a tank wall thickness as per checksheet or request</p> <p>Extent of Testing: 29 Set spot or as per request</p> <p>Personnel: Must be ISO 9712/PCN UT Level II qualified</p> |
| 068019736 | Hardness Testing Onsite Testing | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>Extent of Testing: 3 Set or as per request</p> <p>Reports: Must be signed by Operator & Metallurgist or Technical Manager.</p> |
| 068020727 | Replica Onsite Testing | <p>Tests should be in accordance with ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>Reports: Must be signed by Operator & Metallurgist or Technical Manager.</p> |
| 068020550 | Chemical analysis / PMI - Positive Material Identification Onsite Testing | <p>Standard: ISO, AWS, ASME, PD5500 or whichever code is required.</p> <p>Extent of Testing: As per request or checksheet. The carbon content must be inclusive.</p> <p>Reports: Must be signed by Operator & Metallurgist or Technical Manager.</p> |

| | | |
|-----------|---|---|
| 068020728 | NDT LEVEL 3 Services for UT, PT, RT, MT, and VT: | <p>NDT Personnel with Level 3 qualification in VT, PT, MT, UT, and RT in accordance with ISO 9712/PCN.</p> <p>NDT LEVEL 3 Services for UT, PT, RT, MT, and VT: Assist with the facilitation of NDT methods with regards to procedures, standards, and specifications for Transnet Engineering on a consultation base for all depots requiring the services.</p> <p>NDT LEVEL 3 Services for UT, PT, RT, MT, And VT: Assist with the facilitation of NDT methods with regards to personnel certification and authorisations for Transnet Engineering on a consultation base for all depots requiring the services.</p> |
| 068020740 | Emergency Work / Afterhours (Additional Cost Above the Normal Price) | <p>Any tests which fall on a defined Weekend/Public Holiday</p> <p>Example = (Price) X 1.5</p> <p>This the value or percentage will be used to multiply any price of work done afterhours.</p> |

7. AREA OF WORK

The work will take place at Wagons Manufacturing, Transnet Engineering. The activities to be conducted on newly built, in-service, or recertified wagons include the following:

- Inspecting and testing of pressure equipment in line with PER – Regulation 11, on a three-year cycle.
- Inspecting weld repairs, welded components, and pressure equipment according to OHS Act, AAR, ASME, ISO, PD5500, and SANS standards.
- Performing non-destructive testing on pressure equipment, viz. RT, MT, UT, PT, etc.
- NDT testing as per various manufacturing or construction codes.
- Welder approval in accordance with various manufacturing or construction codes.
- Procedure qualification record to various manufacturing or construction codes.

8. DESCRIPTIONS TO RENDER SERVICES

The selected service provider must possess a proven history of successfully performing and providing non-destructive testing services for castings, forgings, and weldments.

Various welded components necessitate testing to verify their soundness and structural integrity. The specific requirements will be outlined in the NDT plan, drawings, codes, and/or specifications, which may include recommendations from the AIA or the customer.

9. COMPANY FILE AND REQUIRED DOCUMENTATIONS

9.1.1 NDT personnel documentation will consist of the following;

- Valid NDT method certificates to the required level of certification for all inspectors.
- Technicians valid eye test certificates.
- Technician updated work experiences logbooks.
- Technicians company authorisation in the relevant NDT methods by the company NDT Level 3.
- All EPD records must be monitored when inspectors are working with RT.

9.1.2 Company NDT procedures, codes, standards and specifications with regards to the following:

- Latest revised company written practice in accordance with the stipulated certification scheme.
- Latest revised NDT methods procedures for each NDT methods, adhering to the latest governing codes, in respect to the components under inspections.
- Latest revised NDT industry standards that serve as guidelines concerning the inspections of various components.
- Latest revised technique sheets that describe the process of each inspection method compiled for a particular component.
- Latest revised and updated acceptance criteria and quality levels, which are governed by the current international manufacturing quality codes in regard to a particular component under inspections.
- Report formats also must be submitted in the company file.

9.1.3 Test and measurement equipment documentations:

- Valid calibrations certificates of all equipment that will be utilised on site when carrying out the inspections.
- All calibrated equipment used to assess the quality of the constructions shall be suitably controlled and calibrated at specific intervals as per designated guiding standard ISO 17025 recommendations.
- All calibrated equipment must have a calibration certificate; and must documented. A calibration sticker should be clearly visible on the equipment after the calibration.
- Calibration dates should be adhered to as per schedule.
- All calibration equipment shall be checked regularly to assess if the equipment conforms to the requirements as per supplier/customer recommendations. An equipment calibration and validation register shall be maintained.
- If the calibration is outsourced, the supplier performing calibrations shall be in possession of an appropriate accreditation; the supplier shall provide the manufacturer with calibration certificates for the equipment.
- Records of all equipment serial number that is being utilizes on the inspected components will be maintained.
- Equipment performance check records which will cover the following required equipment performing characteristics in the respective NDT methods;

a) Magnetic Particle Testing

- Lift block test/calibration of the yoke,
- Verification of yoke magnetic direction using magnetic field indicators,
- White-light meter value readings records,
- UV(A) light meter (working/reference),
- Black light level intensity checks on the test surface,
- Visible light level intensity checks on the test surface,
- Magnetic particle concentration check,
- Permanent magnet and magnetic yokes,
- Magnetic particle solution (visible/fluorescence),

- Magnetic inks (for aerosols),
- Reference Weights (for checking strength of magnet),
- Gauss meter & Ammeter.

b) Ultrasonic testing

- Linearity of the time base or horizontal linearity,
- Linearity of equipment gain or vertical linearity,
- Sensitivity of the flaw detector,
- Signal to noise ratio of the flaw detector,
- Penetrating power of the flaw detector,
- Resolving power,
- Transmitter pulse characteristics,
- Probe indexes point verification,
- Actual probe beam angle,
- Probe beam spread profile,
- Probe beam alignment,
- Visual check for damage,
- Calibration of time base,
- Overall system gain.

c) Radiographic Testing

- Gamma Ray – Source Size and X-Ray – Focal Spot Size,
- Densitometer,
- Film density strip,
- Survey meters,
- Digital Radiography,
- Optical Density Step Wedges,
- Optical Line Pair Test Pattern,
- Film viewers,
- Dosimeters,
- Source container documentation,

- Lead bags,
- Isotope pig tail tongs,
- Isotope storage/ bomb pit,
- Any utilised analysis software certificates/licenses.

9.1.4 Latest revised toolbox-talks templates that will comprise of various safety topics that cover the hazardous identification and risk assessments. Inspectors must read and understand this before each shift commences. This is aimed at making personnel aware of all the dangers associated with the working environment or vicinity and apply necessary safety measures in order to prevent any unsafe incidences to occur whilst conducting the inspections.

9.1.5 Material Safety Data Sheet – to record all consumables used during the inspections process.

10. PREPARATIONS AND REQUIREMENTS FOR RADIOGRAPHIC TESTING (RT)

- **PROTECTION AGAINST IONIZING RADIATION**

WARNING — Exposure of any part of the human body to X-rays or gamma-rays can be highly injurious to health. Wherever X-ray equipment or radioactive sources are in use, appropriate legal requirements shall be applied. Local, national, or international safety precautions when using ionizing radiation shall be strictly applied.

- **SURFACE PREPARATION AND STAGE OF MANUFACTURE**

In general, surface preparation is not necessary, but where surface imperfections or coatings can cause difficulty in detecting defects, the surface shall be ground smooth, or the coatings shall be removed. Unless otherwise specified, radiography shall be carried out after the final stage of manufacture, e.g., after grinding or heat treatment.

- **LOCATION OF THE WELD IN THE RADIOGRAPH**

Where the radiograph does not show the weld, high-density markers shall be placed on either side of the weld.

- IDENTIFICATION OF RADIOGRAPHS

Symbols shall be affixed to each section of the object being radiographed. The images of these symbols shall appear in the radiograph outside the region of interest where possible and shall ensure unambiguous identification of the section.

- MARKING

Permanent markings on the object to be examined shall be made in order to accurately locate the position of each radiograph (e.g., zero-point, direction, identification, measure). Where the nature of the material and/or its service conditions do not permit permanent marking, the location may be recorded by means of accurate sketches or photographs.

- OVERLAP OF FILMS

When radiographing an area with two or more separate films, the films shall overlap sufficiently to ensure that the complete region of interest is radiographed. A high-density marker on the surface of the object shall verify this, which is to appear on each film.

- TYPES AND POSITIONS OF IMAGE QUALITY INDICATORS

The quality of image shall be verified by use of image quality indicators (IQIs) in accordance with ISO 19232-1, ISO 19232-2 or equivalent to an appropriate level in the relevant industrial sector.

The IQI used shall be placed preferably on the source side of the test object at the centre of the area of interest on the parent metal beside the weld. The identification numbers and, when used, the lead letter F, shall not be in the area of interest, except when geometric configuration makes it impractical.

The IQI shall be in close contact with the surface of the object. Its location shall be made in a section of uniform thickness characterized by a uniform optical density on the film.

The following shall be considered when to the IQI type used;

- When using a wire IQI, the wires shall be directed perpendicular to the weld and its location shall ensure that at least 10 mm of the wire length shows in a section of uniform optical density, which is normally in the parent metal adjacent to the weld.
- When using a step hole IQI, it shall be placed in such way that the hole number required is placed close to the weld.

- **EVALUATION OF IMAGE QUALITY**

The films shall be viewed in accordance with ISO 5580 or equivalent.

From the examination of the image of the IQI on the radiograph, the number of the smallest wire or hole, which can be discerned, is determined. The image of a wire is accepted if a continuous length of at least 10 mm is clearly visible in a section of uniform optical density.

In the case of the step hole type IQI, if there are two holes of the same diameter, both shall be discernible, in order that the step be considered as visible.

The IQI value obtained shall be indicated on the test report of the radiographic examination. In each case, the type of indicator used shall be clearly stated, as shown on the IQI.

- **MINIMUM IMAGE QUALITY VALUES**

The minimum quality values for metallic materials are shown on relevant standards as per construction code. For other materials, these requirements or corresponding requirements may be agreed upon by contracting parties. The requirements shall be determined in accordance with ISO 19232-4 or equivalent.

In the case where IQI values worse than the ones listed in relevant standard may be accepted by agreement of contracting parties as per standards recommendations.

11. TEST RECORDS

An inspection test record is required for recording the specific feature observed during inspection process and handed over to the client within 24 hours after the test completion. The format of the inspection test record will vary according to the inspections task. Test conditions under which NDT is performed, and NDT results must be documented in written or electronic test reports.

Test reports must contain at minimum the following:

- The name of the laboratory or approved inspecting authority.
- The product standards, specification or code or inspection procedure, including any applicable visual references.
- The date and place of inspection and the inspectors name and identification.
- Identification of the items or areas inspected and, if 100% inspection was not carried out, the number or percentage of items or areas inspected.
- The conditions at time of inspection including the following;
 - Lighting natural or artificial and that it meets the requirement of inspection standards.
 - Access – restrictions.
 - Surface condition and the methods and degree of surface penetration.
 - Other factors that may adversely influence scrutiny of an area.
 - Weather condition, if relevant.
- Stages of manufacturing at time of inspection or know service history of the component.
- Measuring equipment and individual identification. Record the magnification if used.
- Report number and date of issue.
- Visual inspection findings including acceptability or compliance with relevant specifications, if required.
- Any department from the inspection procedure.
- Sketches and photographs showing details of specific features shall be attached to the inspection test record.

- The inspector who conducted the inspection and verified by a counter signature of a certified NDT level 2 will sign off all NDT reports.

Radiographic testing

For each exposure, or set of exposures, a test report shall be made giving information on the radiographic technique used, and on any other special circumstances, which would allow a better understanding of the results.

The test report shall include at least the following information:

- name of the examination body,
- object,
- material,
- heat treatment,
- geometry of the weld,
- material thickness,
- welding process,
- quality levels,
- inspection code,
- acceptance criteria,
- specification of examination including requirements for acceptance,
- radiographic technique and class, required IQI sensitivity in accordance with this part of ISO 17636 or equivalent,
- test arrangement in accordance with the applicable construction standard,
- system of marking used,
- film position plan,
- radiation source, type and size of focal spot and identification of equipment used,
- film type and system, screens and filters,
- tube voltage used and current or source type and activity,
- time of exposure and source-to-film distance,
- processing technique: manual/automatic, and development conditions,
- type and position of image quality indicators,

- results of examination including data on film density, IQI readings,
- any deviation from this part of ISO 17636 or equivalent, by special agreement,
- name, certification and signature of the responsible person(s),
- date(s) of exposure and test report.

12. TESTING OF THE REPAIRS

Repairs that need re-inspections, the time of re-test will be agreed upon by the line supervisor with the NDT technician largely depending on the organisational production requirements and prioritised schedule. The NDT service provider must keep record of both the defect, and no defect test reports for repairs.

Re-tests on the repairs will be carried out before the end of shift were possible, but in case were a certain manufacturing quality codes dictates prerequisite parameters such as preheating or cooling rate before any inspection can be conducted, the governing guidelines in the relevant code will be adhered to.

13. ACCEPTANCE STANDARD

Acceptance and rejection will be based on a level of agreement reached between the parties involved, in line with the project requirements.

14. PERSONNEL QUALIFICATION

Personnel shall be qualified in accordance with ISO 9712 or PCN.

Personnel shall be authorized in accordance with registered and approved written practice shall only carry out the examination.

Level 2 and Level 3 personnel may only conduct evaluation of inspection results.

15. QUALITY OF WORK

All work performed will be conducted to standardized industry quality requirements, in terms of all the European, British, American, Australian, etc. governing guidelines set forth within their inspection and quality codes, specifications, procedures and standards.

Work shall be carried out in a safe manner that does not cause any damage to the environment and its inhabitants in the surrounding vicinity.

Operators are to ensure that the work performed is of high-quality standards set forth in the code of ethics for NDT operators governed by the ISO 9712 or other codes recommended by Transnet Engineering.

16.RECORDS KEEPING

All test records and reports must be maintained and stored accordingly for a prescribed period. This is to ensure that the records may be produced should the client request the documents in the future and form traceability of all records for audit and review purposes.

The period to which the records will be maintained and stored will be agreed upon by the client and service provider adhering to the governing codes relevant or subsequently digitalizing the radiographs.

17.HEALTH AND SAFETY / CAUTIONARY MEASURES

- All components must be inspected and tested in accordance with codes, drawing, manuals, samples, etc.
- Personnel must be trained and have sound knowledge of working in confined spaces & height.
- TE SHE induction to be conducted before commencing with the duties.
- Service provider must provide their own safety equipment, i.e., PPE, and own working equipment needed to perform their inspections and safety file in place as per OHS act requirements.
- The Service provider personnel will be required to have their own safety file in place prior to conducting any physical work.
- The Service provider will be required to provide their letter/certificate of good standing with the department of labour.
- The Service provider will be required to provide their Company's registration with the department of health for radiation control.

- All personnel forming part of a radiographic team shall meet the requirements stipulated in the IRCP 91-2 document as published by the Department of Health, Radiation Control.
- All radiation safety requirements in the company code of practice for industrial radiography shall be adhered to.

18.KNOWLEDGE

- Failure to provide these services will lead to non-conformances against the responsible service provider.

19.RECORDS

- Test reports
- Radiographic Films
- Delivery report
- Invoices

20. ANNEXURES

N/A

ACKNOWLEDGEMENT AND ACCEPTANCE OF SPECIFICATION

It is hereby acknowledged that the bidder has read and understood all the contents of this specification. Furthermore, the bidder certifies and guarantee acceptance and compliance with this specification;

SIGNED THIS DAY _____

AT _____

BY _____ (Full Name in Block Letters)

IN MY CAPACITY AS _____ (Official Designation)

FOR THE COMPANY _____

SIGNED _____